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Lennox et al.

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(54) **ROTARY EXERCISE SYSTEM**

(71) Applicant: **Maxx Bench**, Wilkes Barre, PA (US)

(72) Inventors: **James J. Lennox**, Shickshinny, PA (US); **David Vorozilchak**, Shavertown, PA (US); **Philip Matthew Hunt**, Kintnersville, PA (US)

(73) Assignee: **Maxx Bench**

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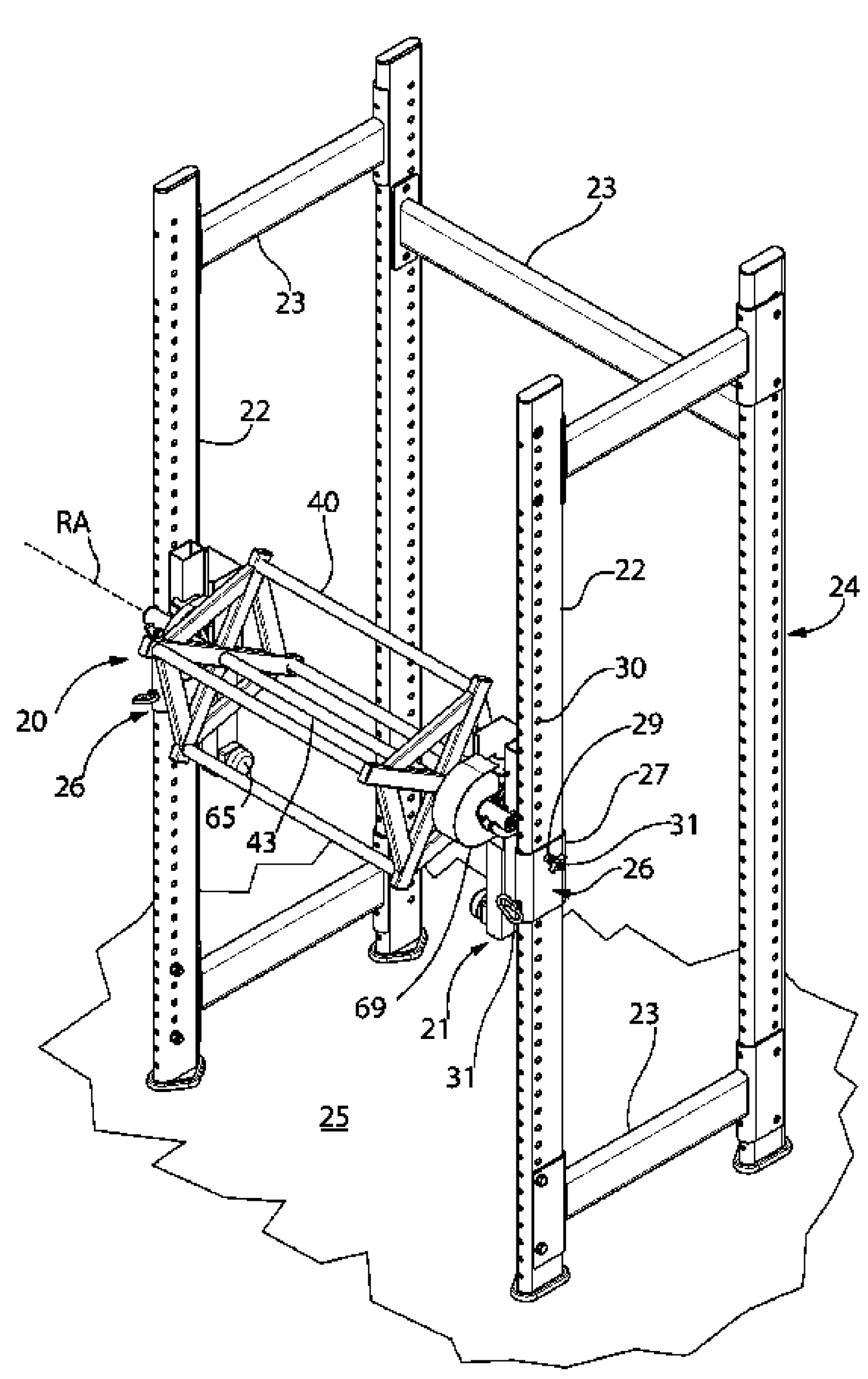
Primary Examiner — Joshua Lee
(74) *Attorney, Agent, or Firm* — The Belles Group, P.C.

(57) **ABSTRACT**

A rotary exercise system in one embodiment includes a chassis configured for mounting to stationary support members, a rotational support shaft rotatably coupled to chassis, and handle bar assembly coupled to the support shaft and manually rotatable therewith by a user. A variable resistance mechanism applies a user-adjustable rotational resistance force on the support shaft, which changes the force required to be applied by the user to rotate the handle bar assembly during an exercise routine. In some embodiments, the resistance mechanism may be a frictional resistance mechanism, such as a drum or disc brake assembly. A user-operated control actuator allows the user to readily change resistance settings to increase or decrease the rotational resistance imparted to the support shaft by the resistance mechanism. In some implementations, the chassis may be detachably mounted on vertical supports of a power rack and adjustable in height for performing different exercise routines.

22 Claims, 12 Drawing Sheets



(51) **Int. Cl.**
A63B 1/00 (2006.01)
A63B 21/012 (2006.01)
A63B 21/068 (2006.01)
A63B 23/12 (2006.01)
A63B 21/22 (2006.01)

(52) **U.S. Cl.**
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(58) **Field of Classification Search**
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See application file for complete search history.

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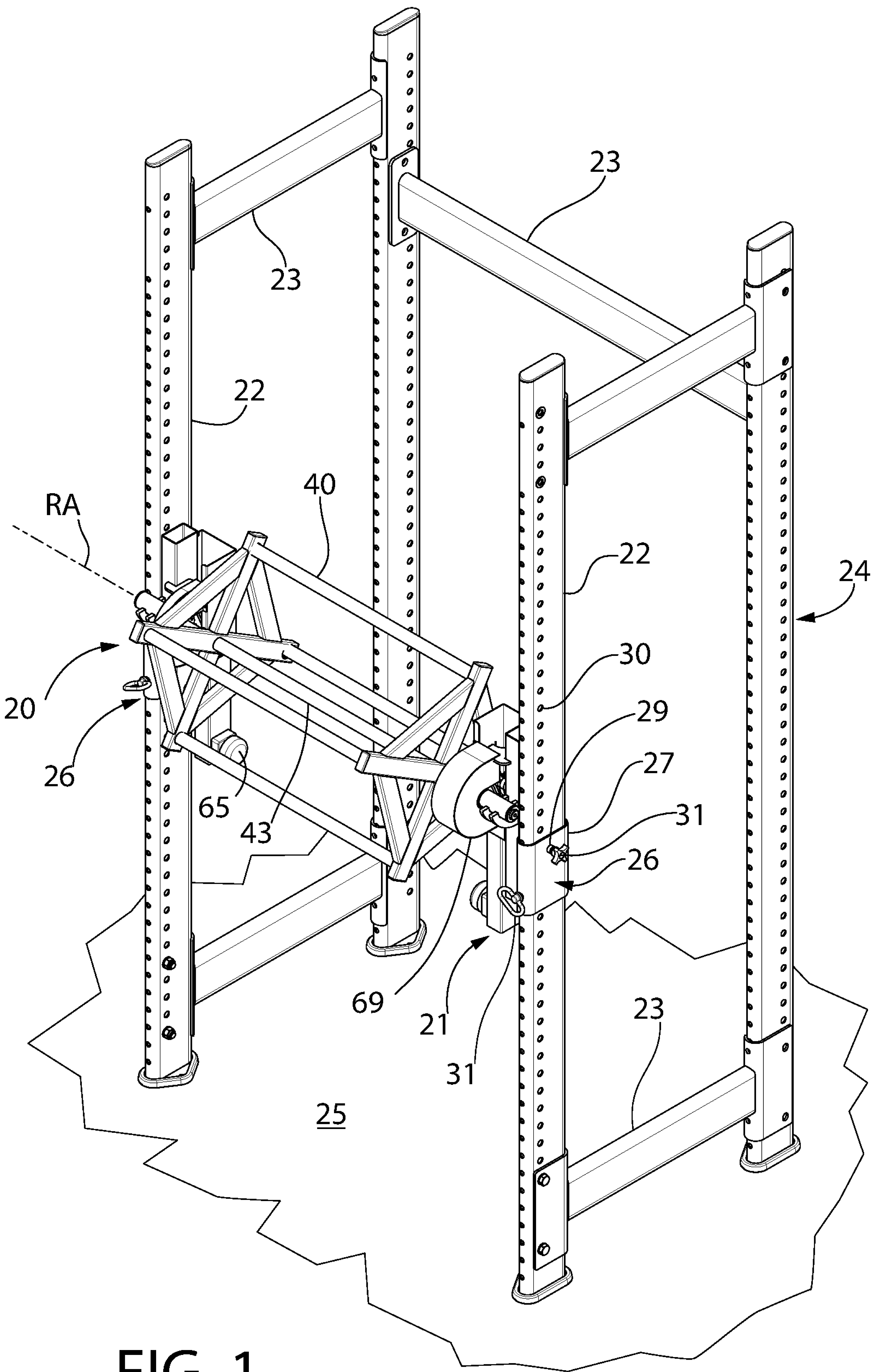

FIG. 1

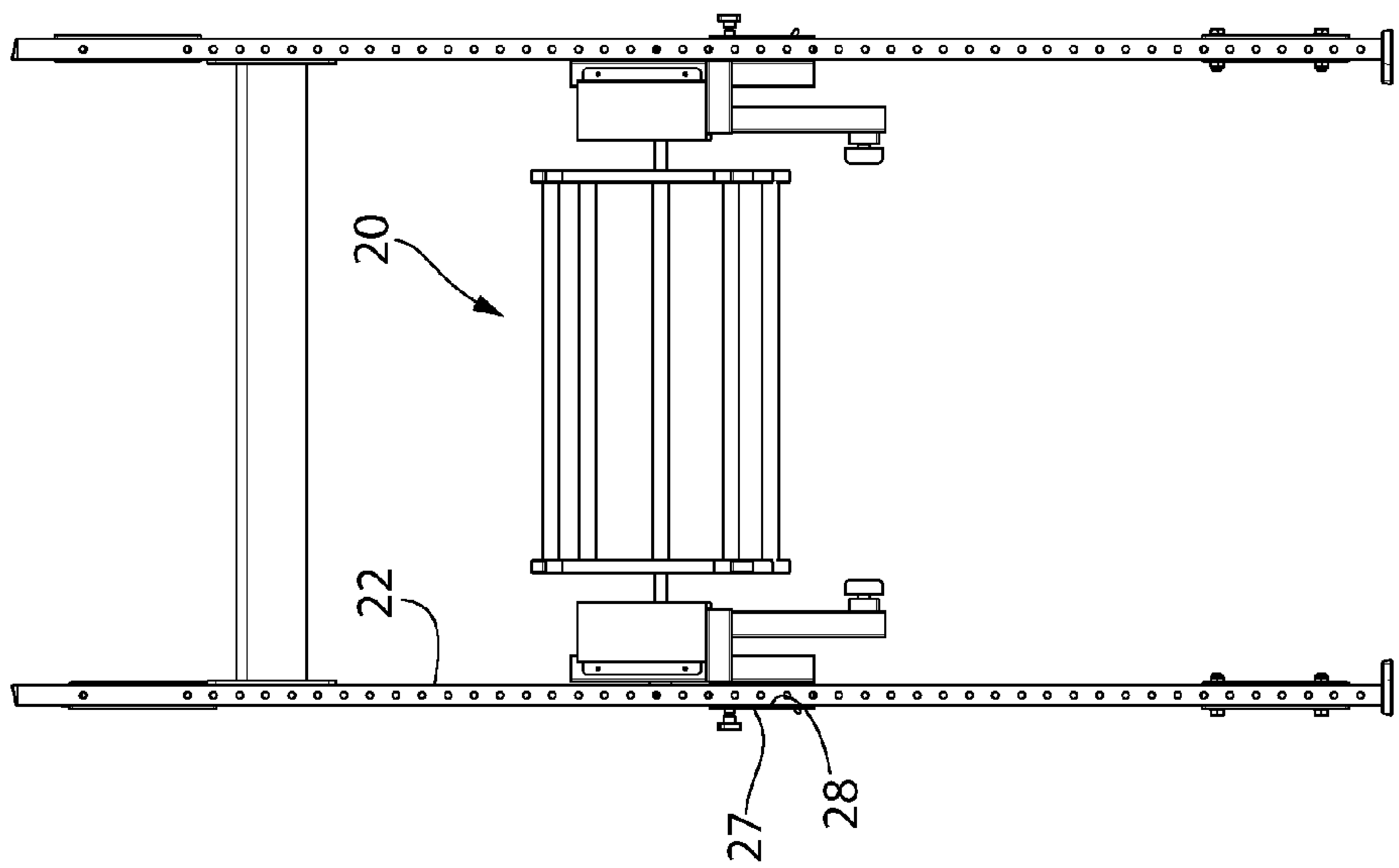

FIG. 3

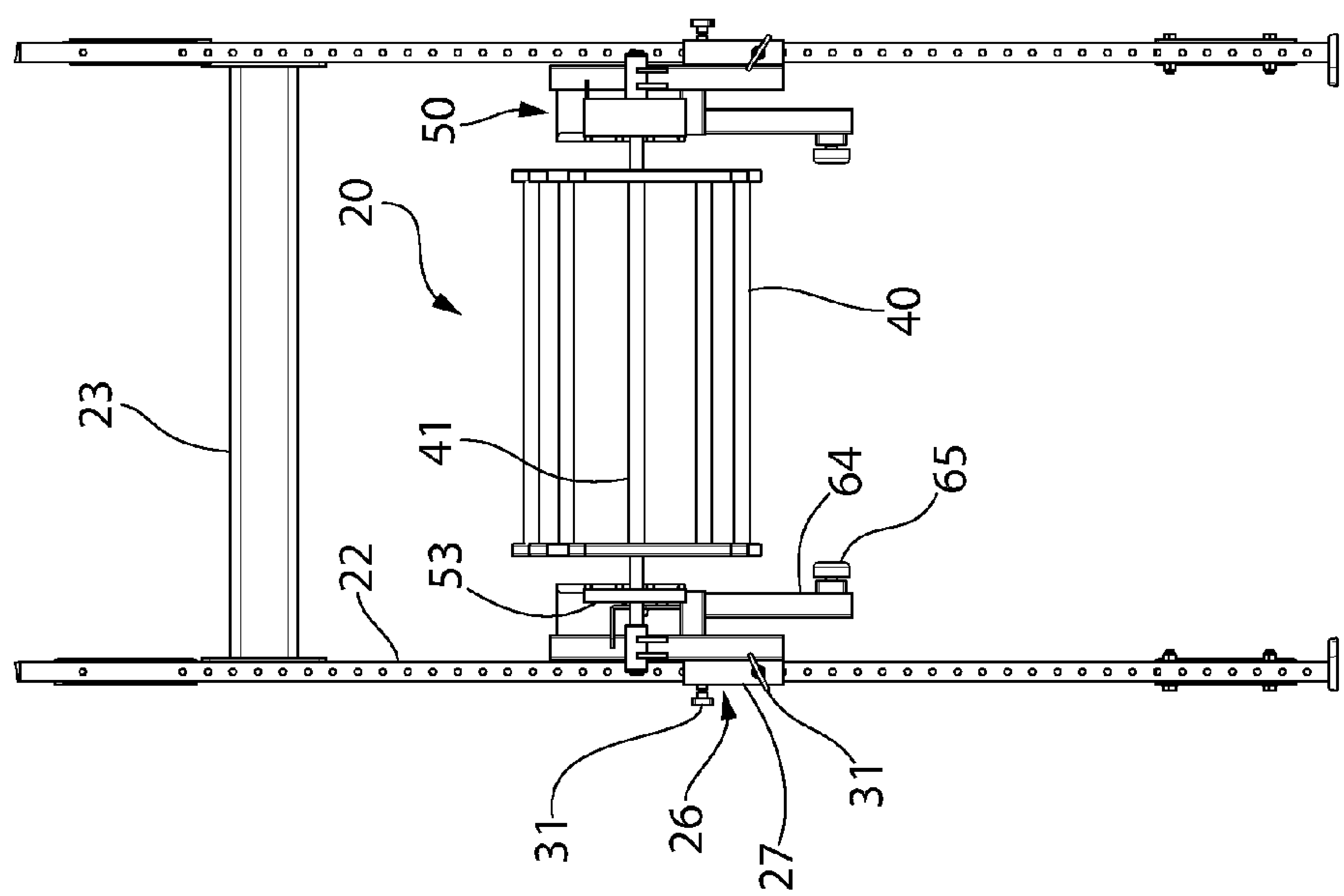

FIG. 2

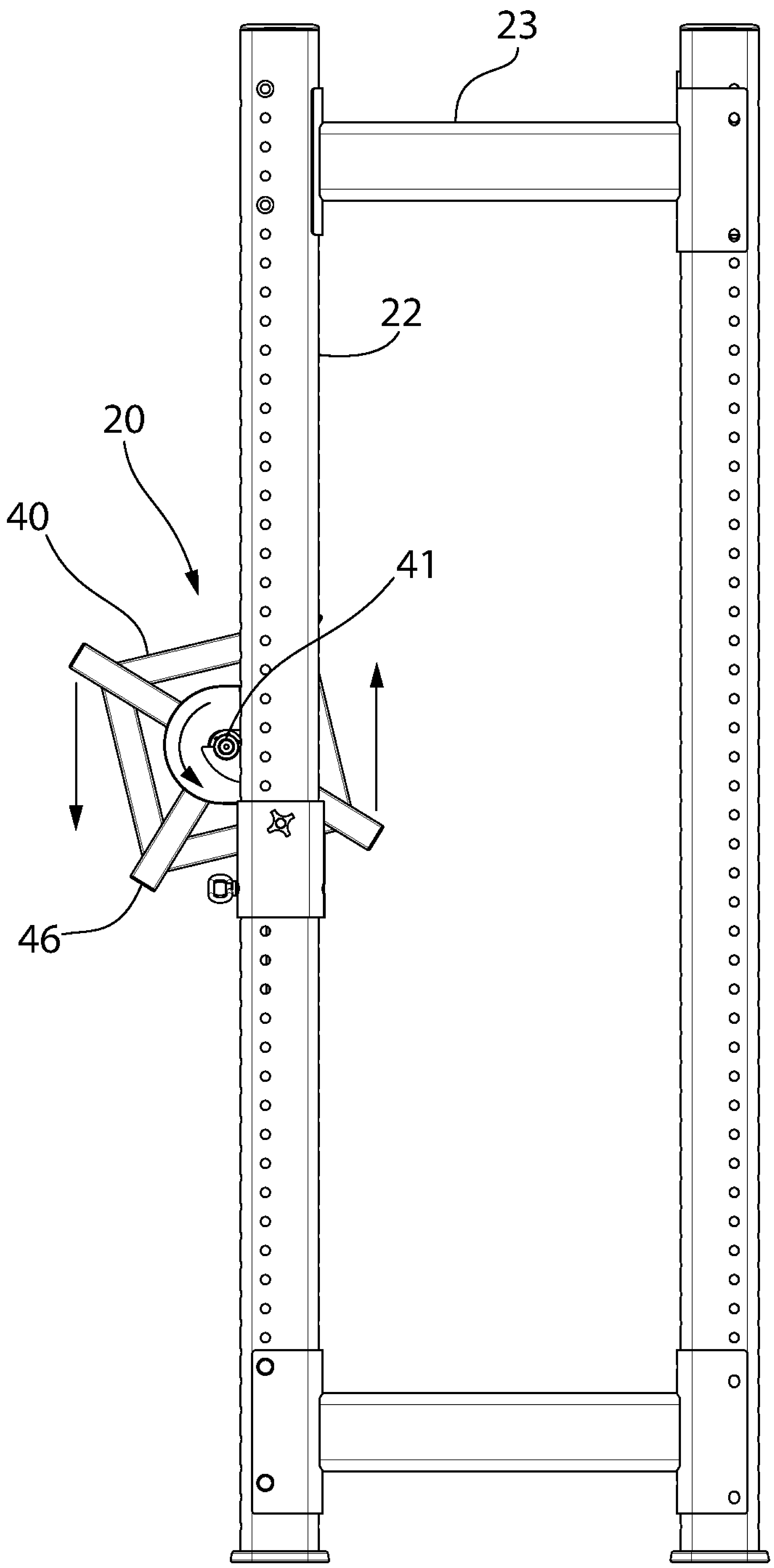

FIG. 4

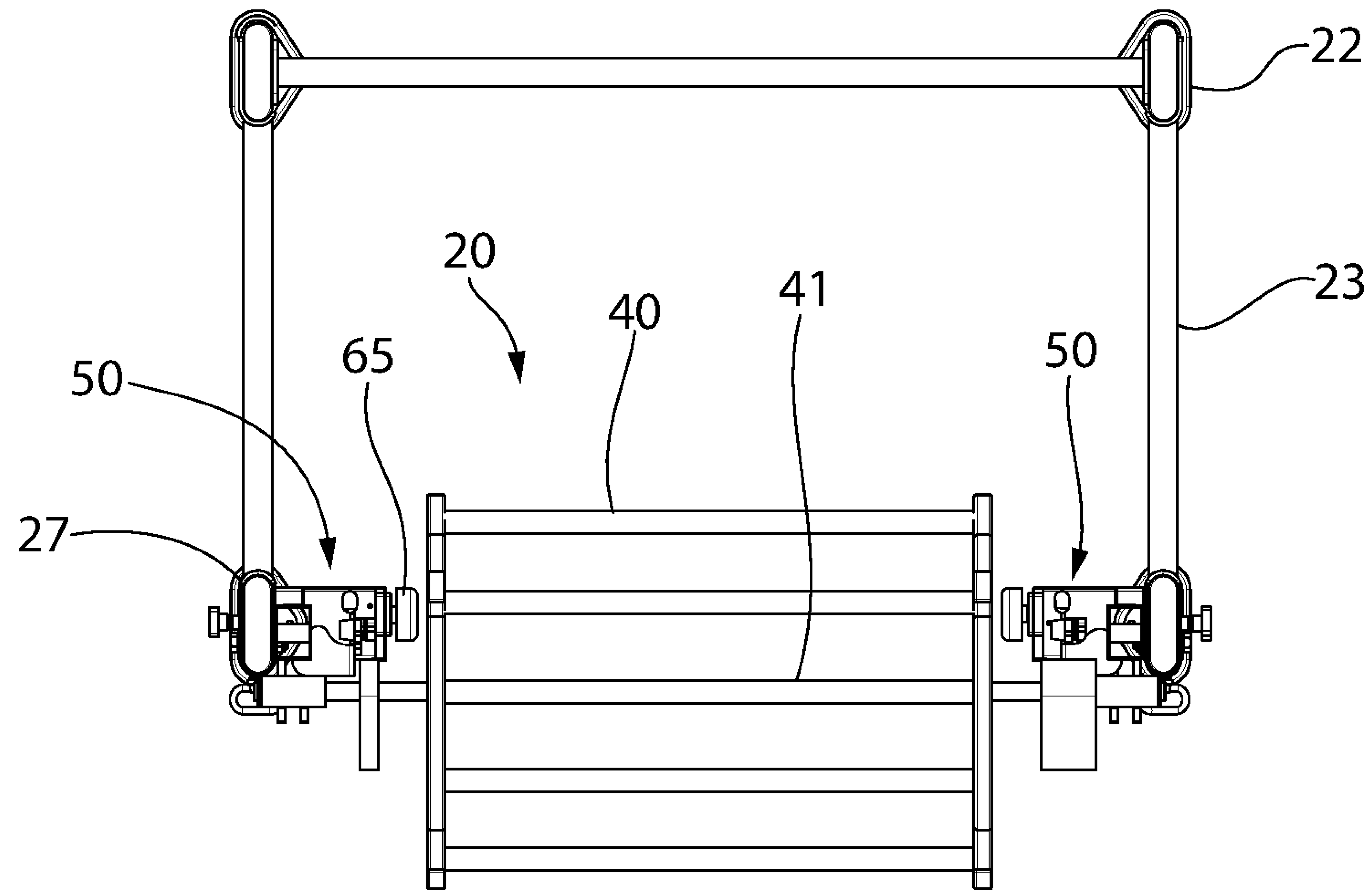

FIG. 5

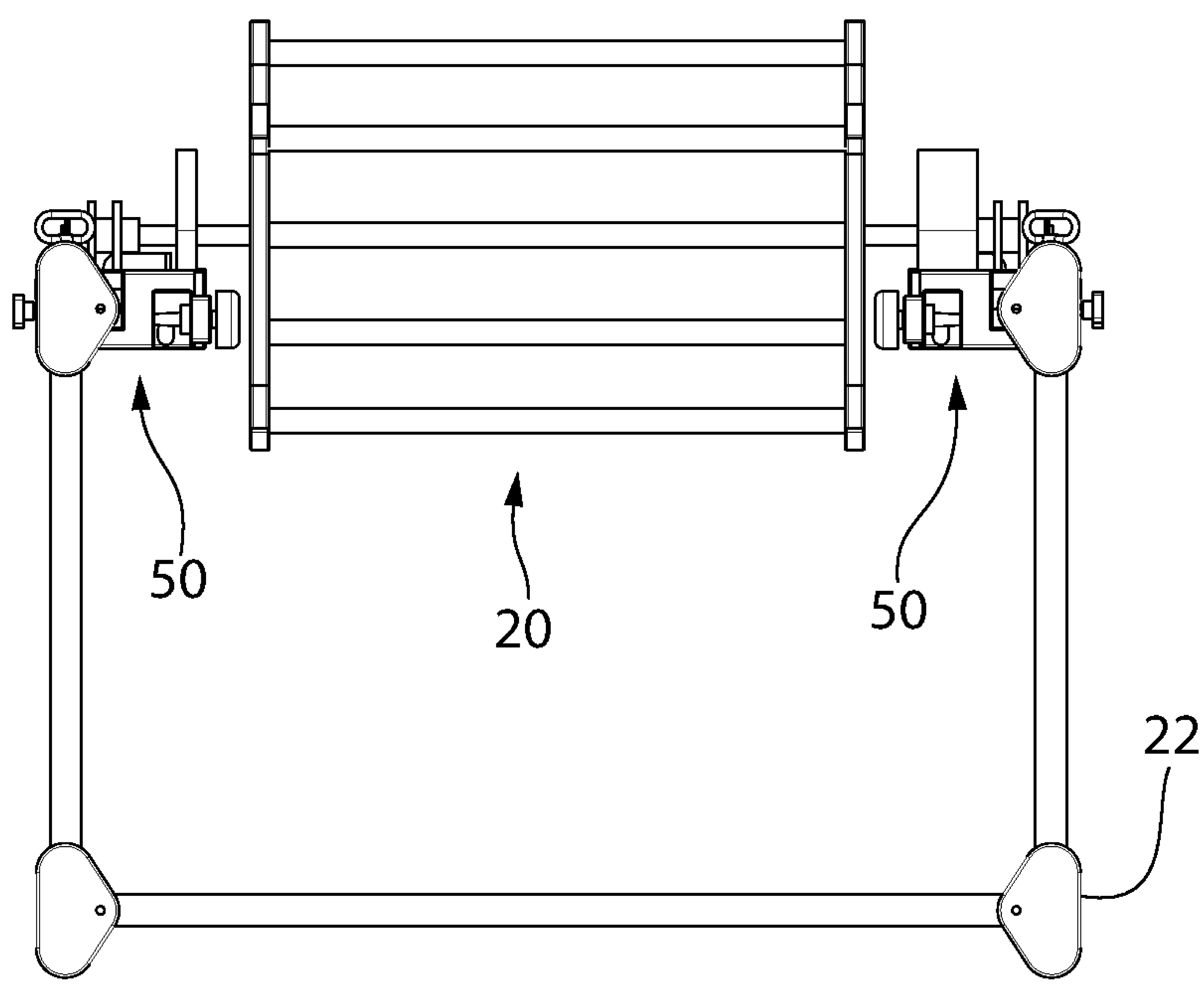

FIG. 6

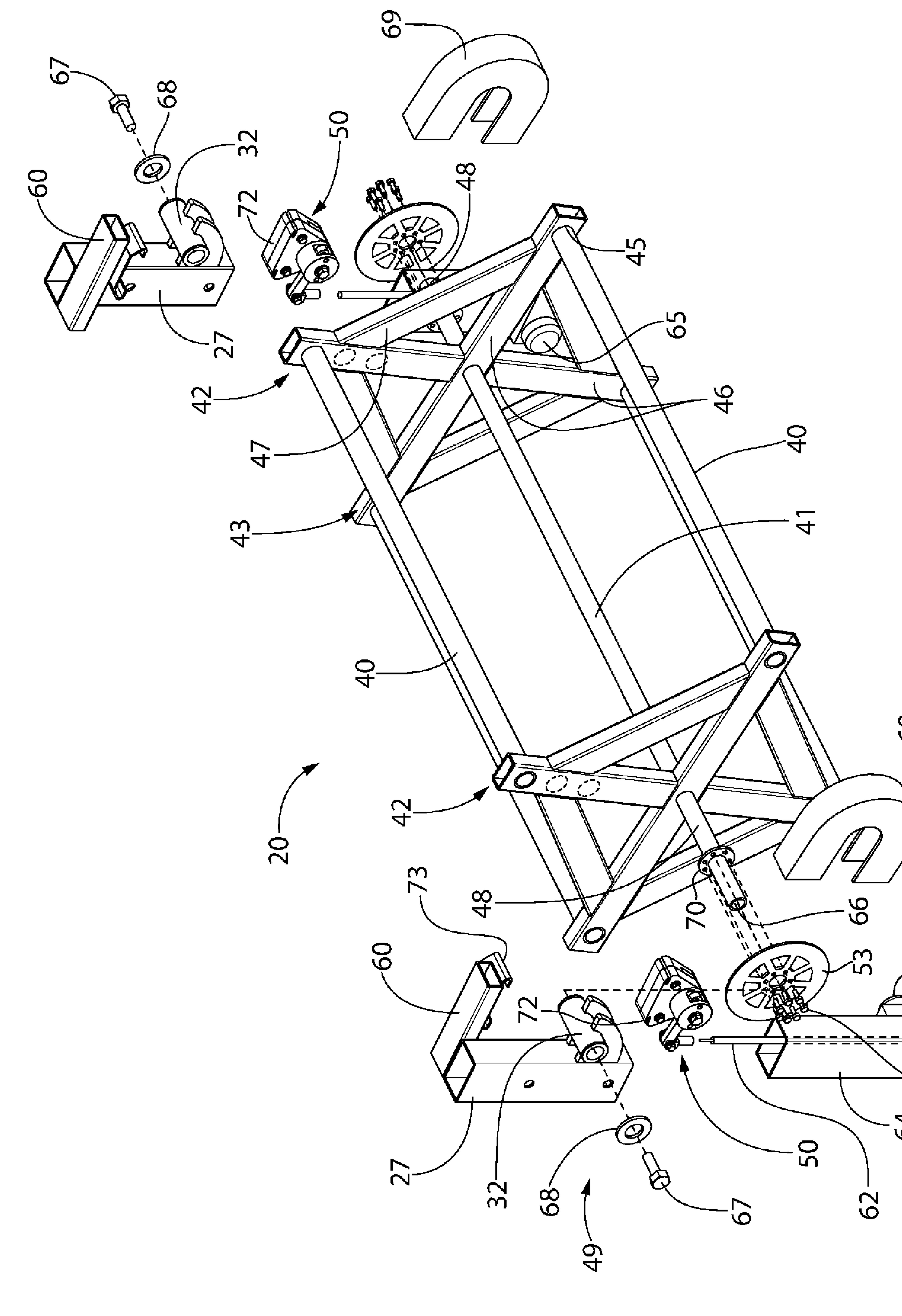
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FIG. 7

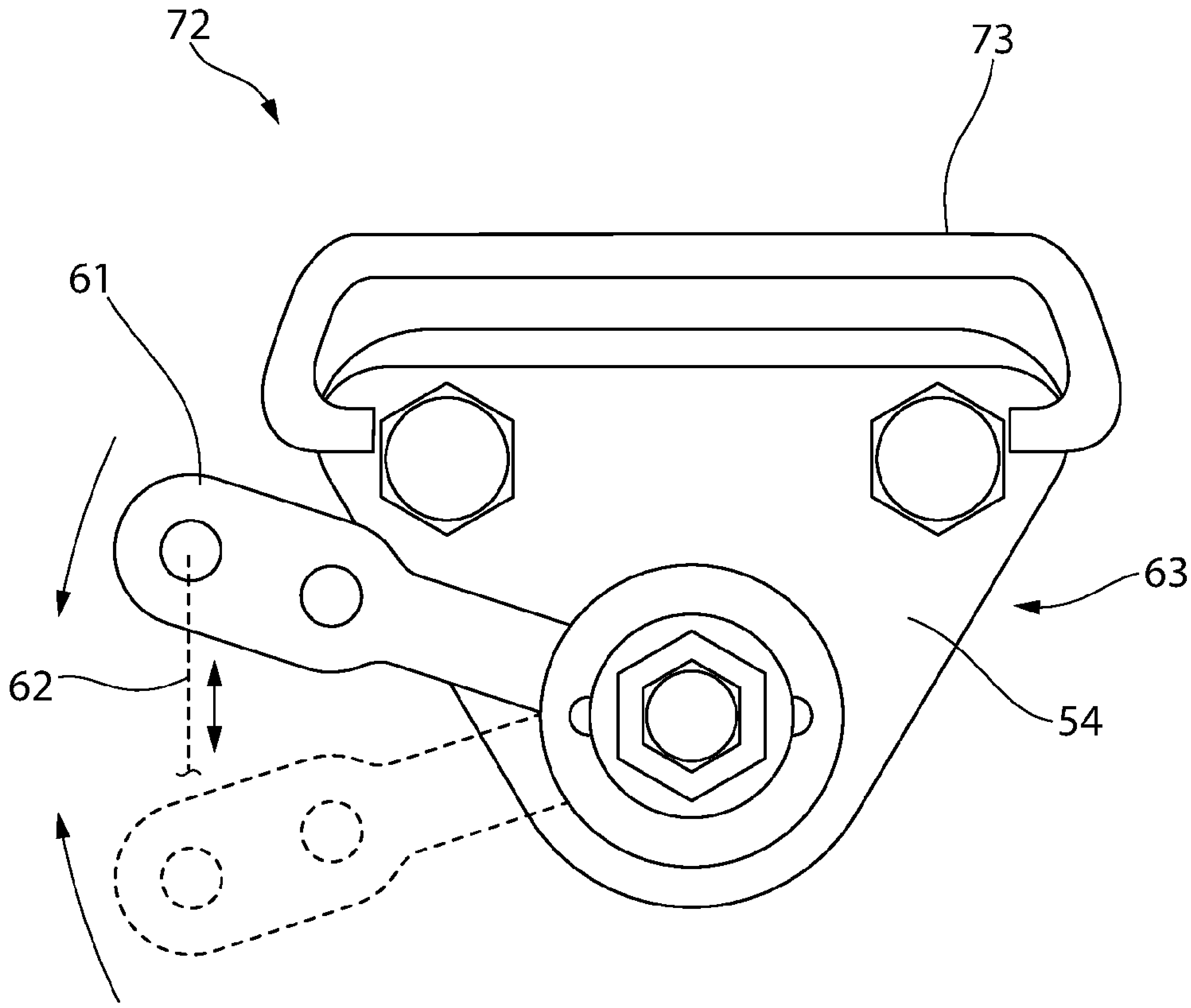

FIG. 8

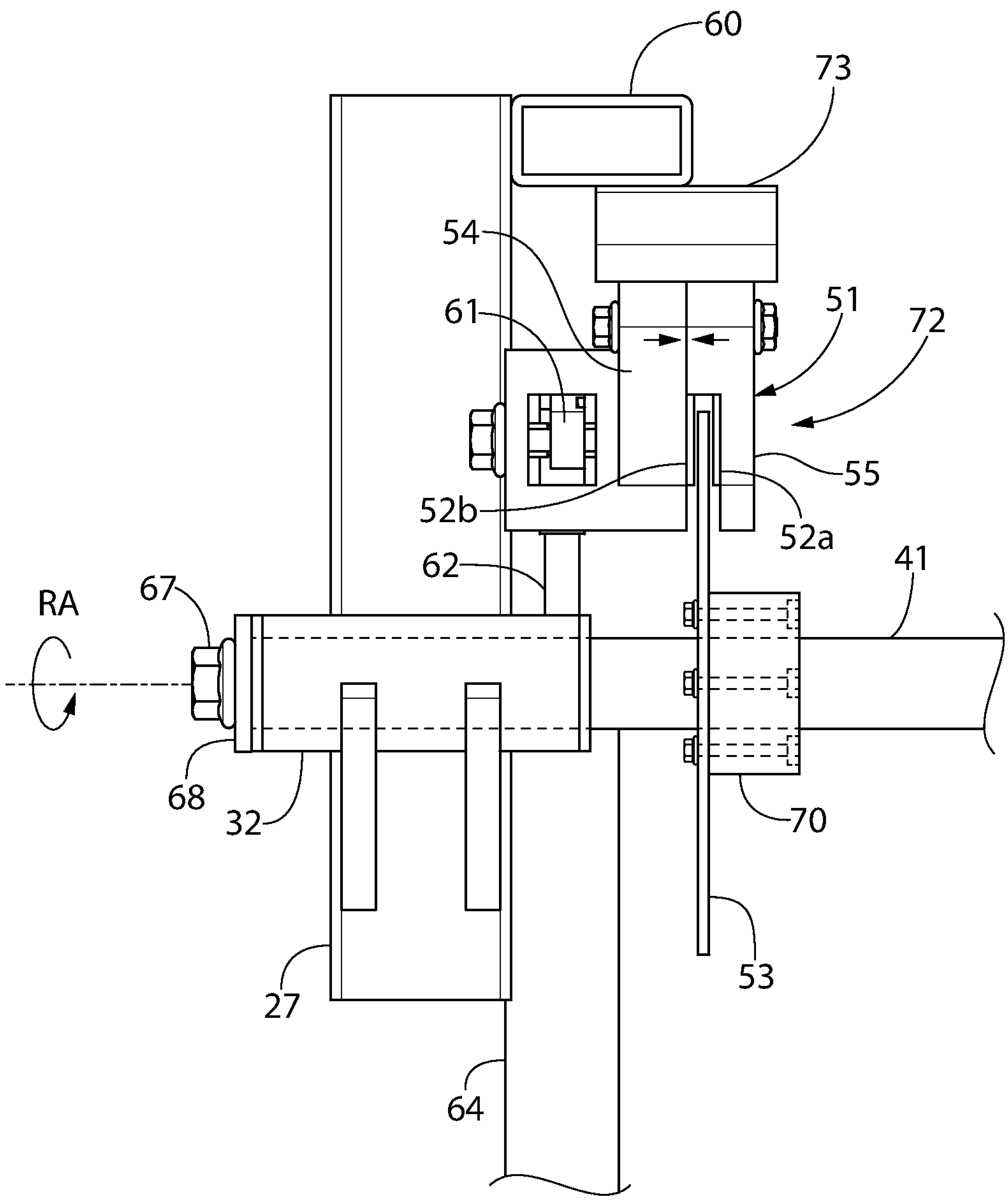

FIG. 9

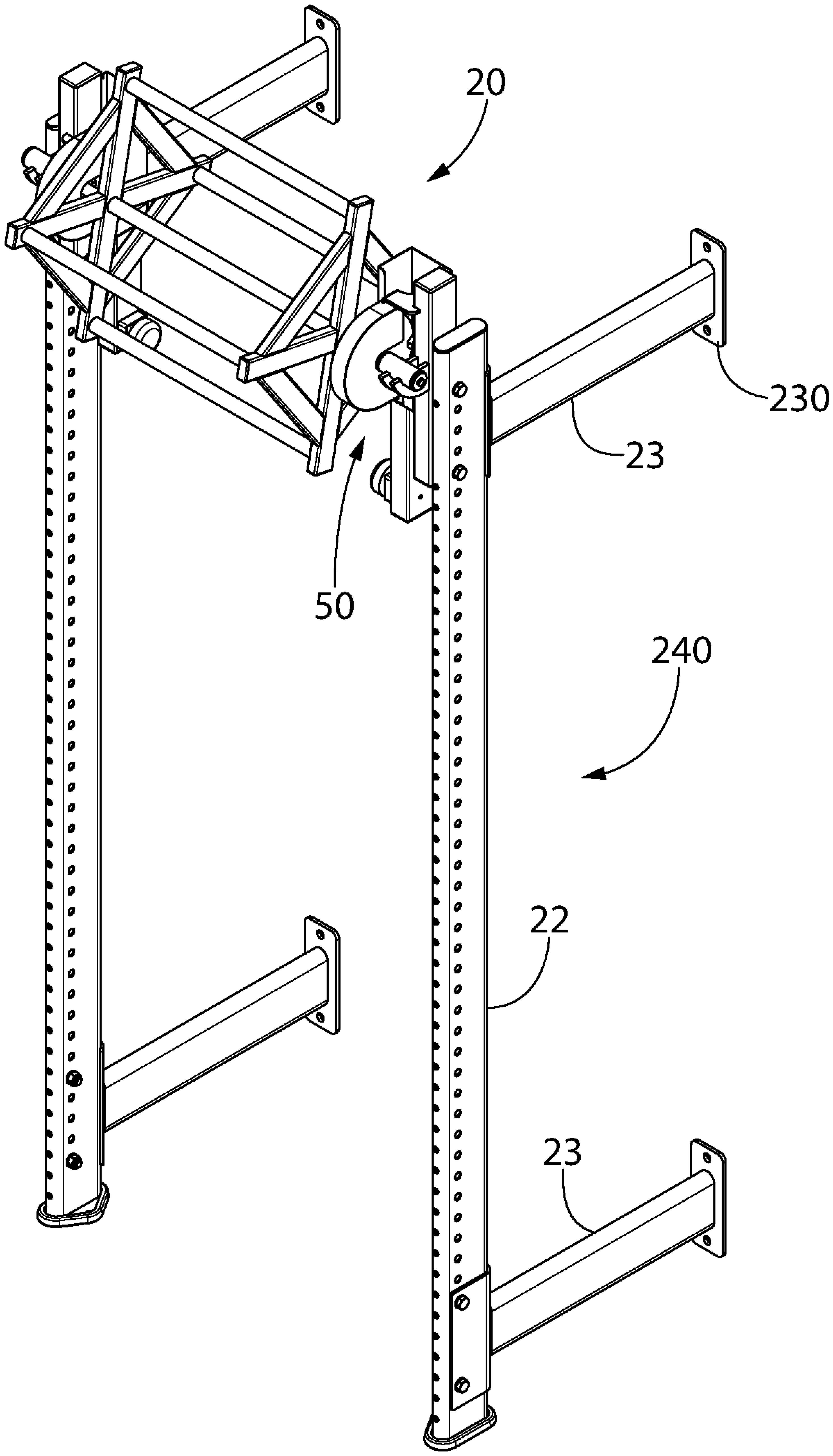

FIG. 10

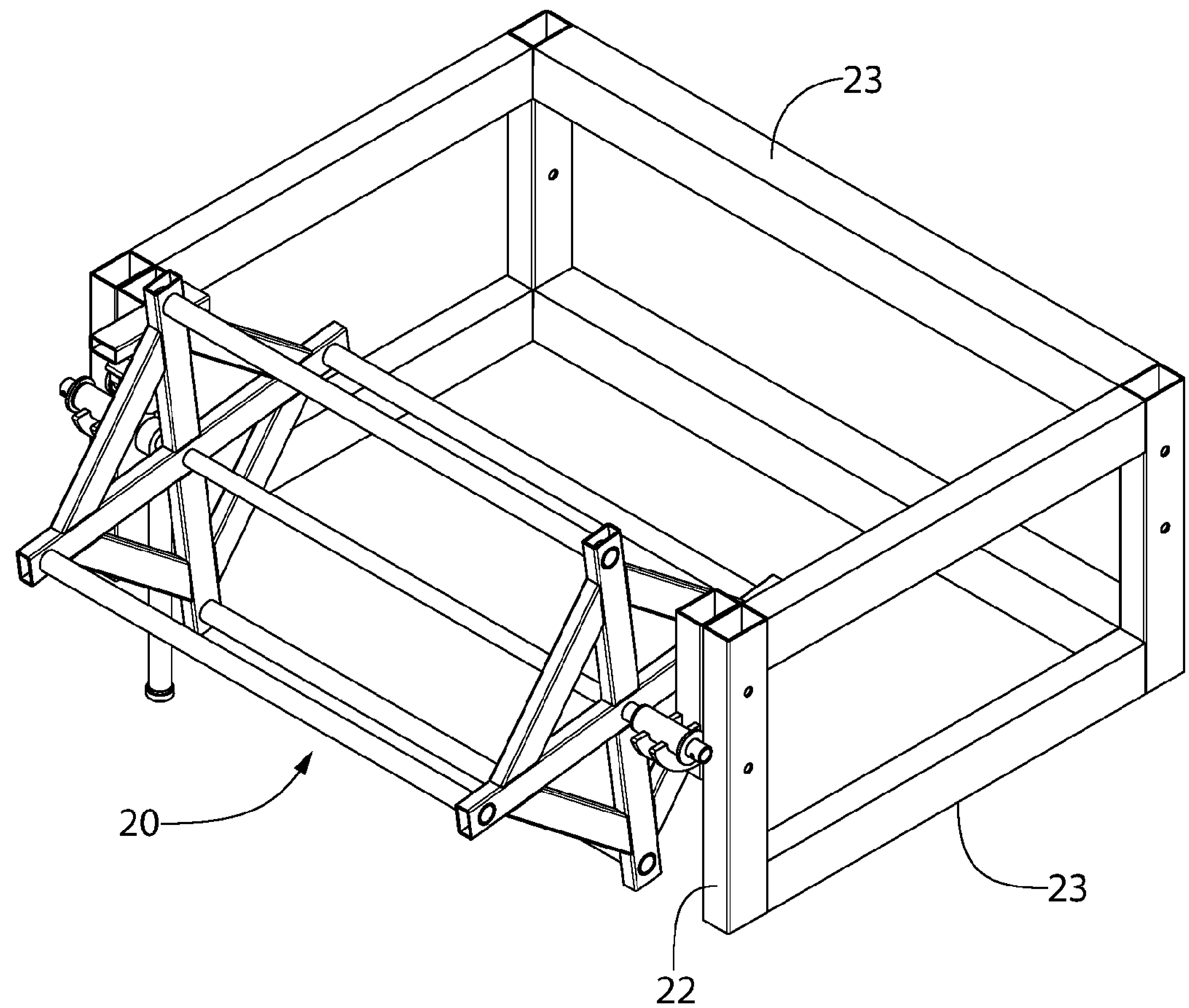

FIG. 11

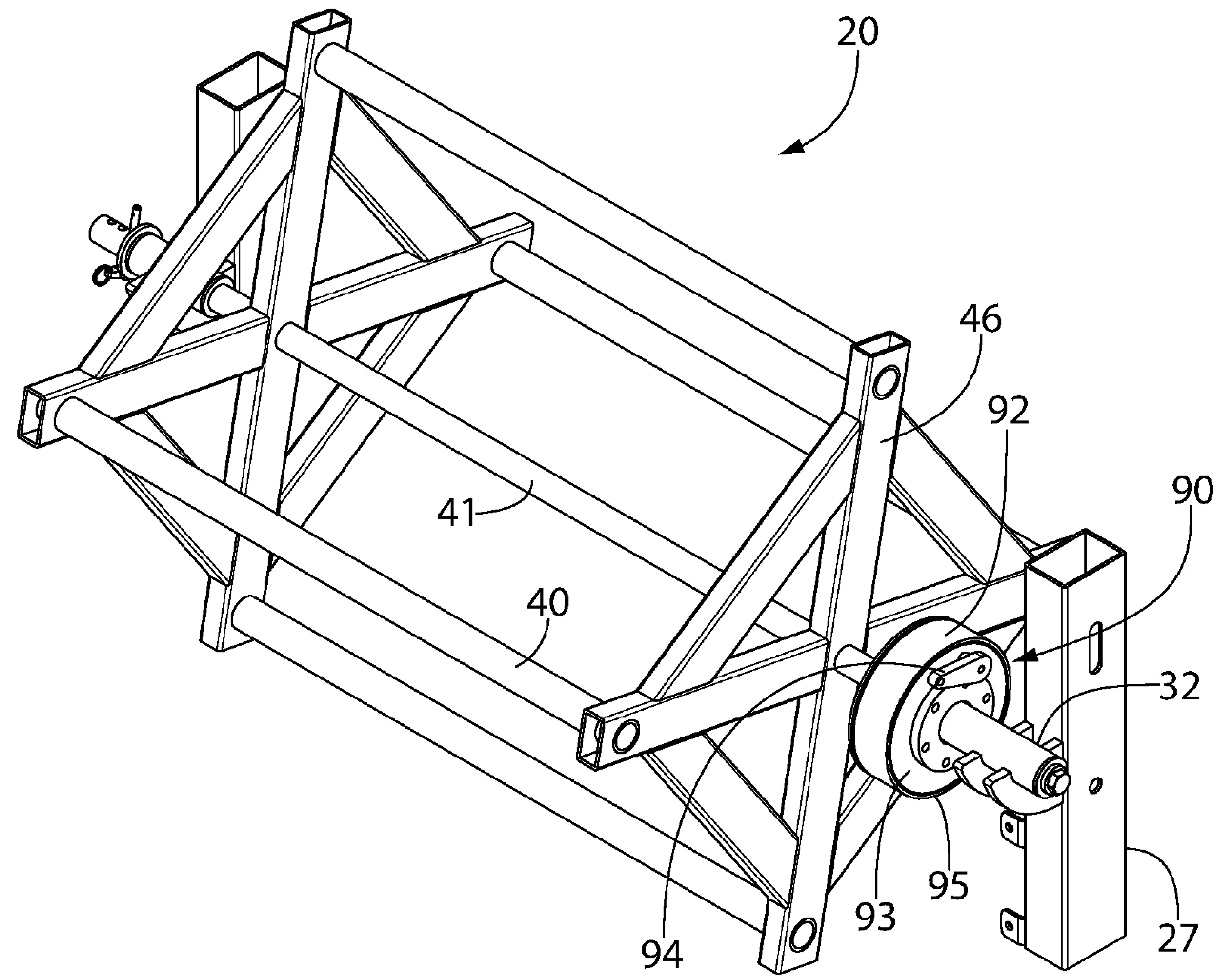

FIG. 12

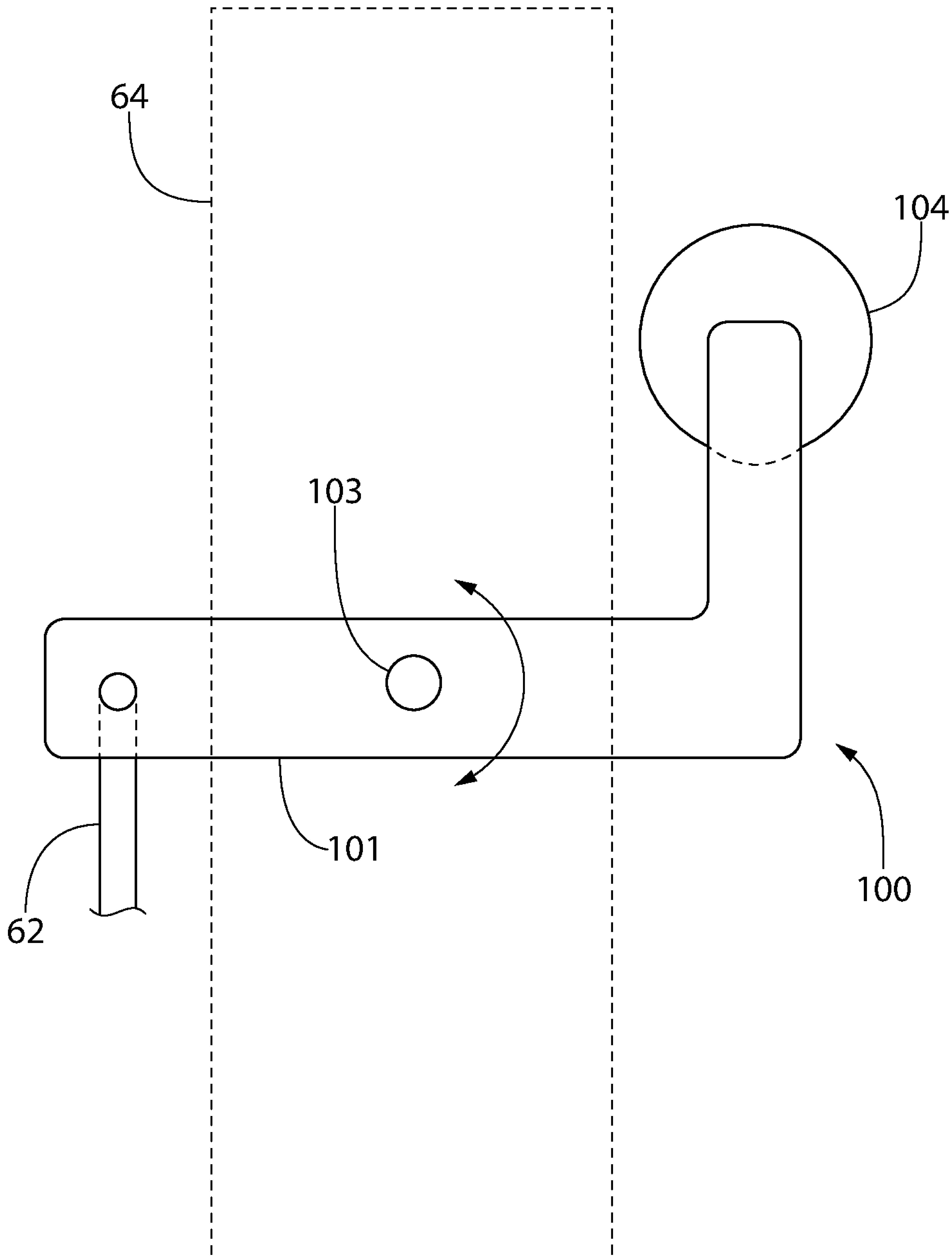

FIG. 13

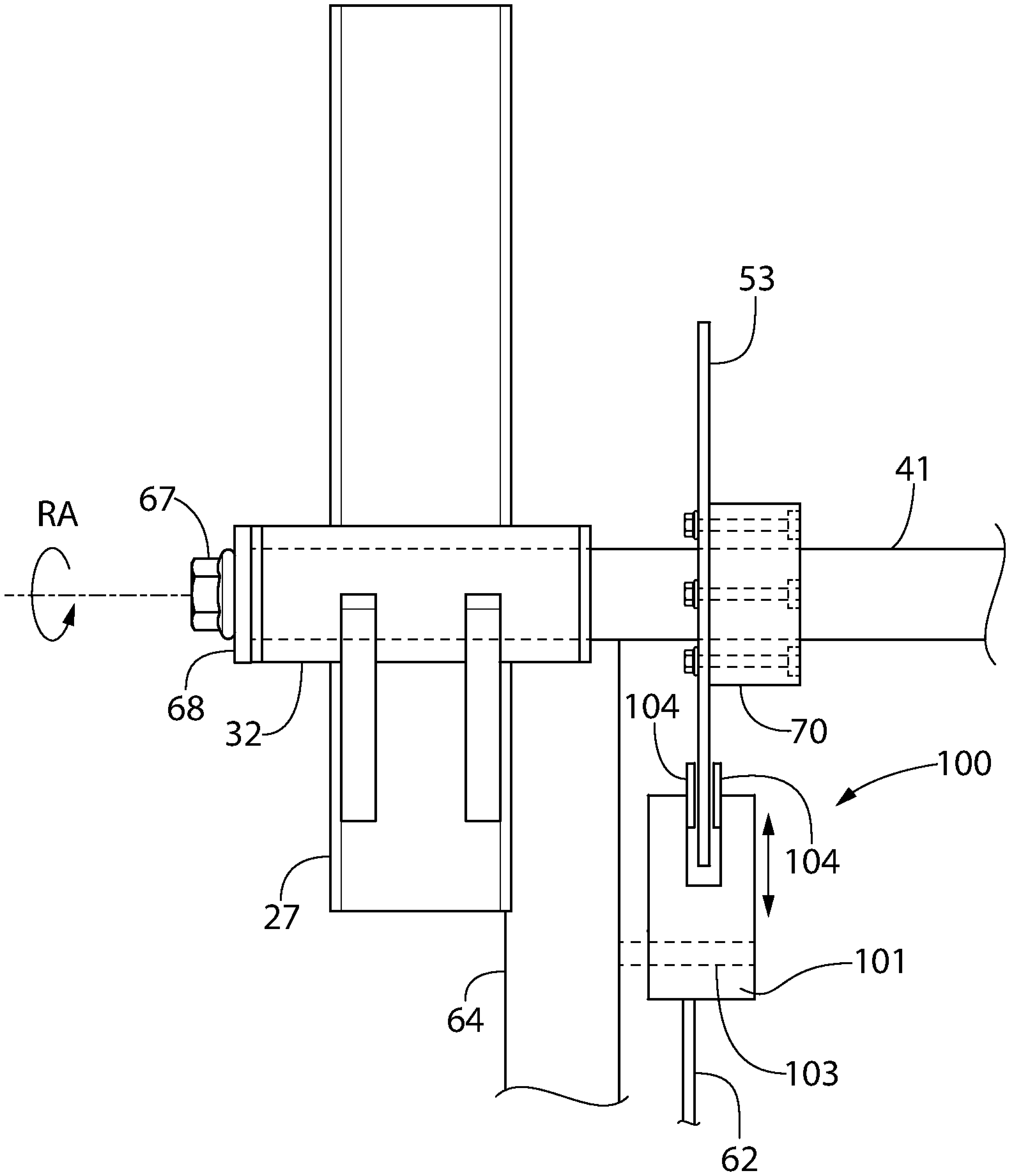

FIG. 14

ROTARY EXERCISE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of priority to U.S. Provisional Application No. 62/369,793 filed Aug. 2, 2016, which is incorporated herein by reference in its entirety.

BACKGROUND

The present invention relates to a rotary exercise system with adjustable rotational resistance to improve training for climbing, pull-ups, CrossFit, general upper body strength, and other forms of fitness.

Traditional means of climbing exercise equipment consume large amounts of space and are potentially dangerous. Elevated monkey bars often seen in CrossFit games, attached to rigs and racks, and included in current multi-functional fitness setups designed for multiple users are designed to elevate users sometimes as high as 12 ft. in the air. Fatigue and muscle failure while climbing these pieces of equipment could prove to be extremely dangerous. Other prior approaches of overhead exercise equipment to simulate continuous climbing or pull-ups include complex designs with many parts, often requiring electricity and motors. Several of the designs utilize a conveyor belt like system with handle bars. Still others may have free spinning handles or bars providing minimal strength training. The foregoing devices further lack versatility for working different muscle groups and performing different exercise routines.

A need exists for an improved and versatile rotary exercise system.

SUMMARY

A rotary exercise system with user-adjustable rotational resistance is described in this application that allows for the same foregoing climbing exercises and motions to be performed in a small space and at a controlled height. The exercise system generally comprises a bi-directionally rotating handle bar assembly rotatably coupled to a support chassis. A resistance mechanism applies a user selectable and adjustable rotational resistance to the handle bar assembly, making it more or less difficult for the user to rotate the handle bars as desired. The handle bar assembly may be mounted at a variety of heights from near the floor and upwards to provide different exercise routines for working various muscle groups including the arms, chest, and legs. None of the prior approaches include a handle bar assembly rotating on a single axis of rotation with adjustable rotational resistance in which the mechanism is directly powered manually by the user.

The rotary exercise system may be used in a variety of mounting positions and heights to permit the user to perform different exercise routines. When the user is suspended freely from the handlebars as in a traditional pull-up exercise, the downward force of gravity of the user's body weight generates a moment about the axis of rotation and thus rotation of the system. When a user is firmly planted on the ground, either sitting or reclining, the force exerted by the user's muscles generates rotation of the rotary apparatus.

The rotating exercise apparatus allows a user to simulate continuous upward climbing while staying in a controlled location, at a controlled height. It creates a unique, space saving climbing experience, a safer environment, an effective work out, and gives users a greater sense of accomplishment and enjoyment compared to standard pull-up bars, inclined monkey bars, rock climbing walls, and free-climbing.

The adjustable rotational resistance control disclosed herein allows the user to regulate the rate of rotation to accommodate users of different body weight and that desired for different exercises. For instance, a larger user with a higher body weight will generate a greater force against the resistance mechanism. By increasing the rotational resistance, the rate of rotation will remain controlled during use. Greater resistance is also beneficial for explosive exercises such as two handed jump pull-ups from bar to bar. By decreasing the rotational resistance, the apparatus accommodates smaller users with lower body weight and higher speed exercises. With different accessories attached to the bars, the rotating resistance climber can provide varied handholds thus giving a comprehensive forearm and grip workout. These handhold accessories can include but are not limited to: ropes, towels, ball grips, rock-climbing hand holds, wooden dowels of varying thicknesses, etc.

With adjustable height and resistance, the rotating resistance system can provide a superior workout for any fitness level. It is usable for elite athletes who can hold their whole body weight and continually climb. It is also usable with less resistance while users stand on the ground and need to work up to full pull-ups with their whole body weight suspending in air while hanging from the handle bars.

In one aspect, a rotary exercise system includes: a chassis configured for mounting between a pair of stationary elongated support members; an elongated rotational support shaft rotatably supported by the chassis, the support shaft rotatable in opposing directions about an axis of rotation; a plurality of handle bars coupled to the support shaft and rotatable therewith, the handle bars arranged to encircle the support shaft and be graspable by a user; a variable resistance mechanism operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user; wherein adjusting the resistance mechanism increases or decreases a physical force required to be exerted manually by a user on the handle bars in order to rotate the support shaft.

In another aspect, a rotary exercise system includes: a pair of spaced apart vertical support members; a chassis comprising first and second mounting rack assemblies, each mounting rack assembly configured for detachable mounting to one of the vertical support members in a plurality of positions; an elongated rotational support shaft rotatably supported by the first and second mounting rack assemblies, the support shaft rotatable in opposing directions about an axis of rotation; a handle bar assembly comprising a plurality of elongated handle bars extending between a pair of side support structures rigidly coupled to the support shaft for rotation therewith, the handle bars arranged for grasping by a user and circumferentially spaced apart around the support shaft; a variable frictional resistance mechanism operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user; wherein adjusting the resistance mechanism increases or decreases a physical force required to be exerted manually by a user on the handle bars in order to rotate the support shaft.

In another aspect, a rotary exercise system includes: a pair of spaced apart vertical support members; a chassis comprising first and second mounting rack assemblies, each mounting rack assembly configured for detachable mounting to one of the vertical support members in a plurality of positions; an elongated rotational support shaft rotatably supported by the first and second mounting rack assemblies, the support shaft rotatable in opposing directions about an axis of rotation; a handle bar assembly comprising a plurality of elongated handle bars extending between a pair of side support structures rigidly coupled to the support shaft for rotation therewith, the handle bars arranged for grasping by a user and circumferentially spaced apart around the support shaft; a frictional resistance mechanism supported by one of the first or second mounting rack assemblies and operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user; a user-operated control actuator operably coupled to the frictional resistance mechanism, the control actuator having a plurality of user selectable resistance settings; wherein adjusting the control actuator to select one of the resistance settings increases or decreases a physical force required to be exerted manually by the user on the handle bars in order to rotate the support shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

The features of the preferred embodiments will be described with reference to the following drawings where like elements are labeled similarly, and in which:

FIG. **1** is a perspective view of a rotary exercise system according to the present disclosure including a rotatable handle bar assembly and floor-supported exercise rack for mounting the handle bar assembly thereon;

FIG. **2** is a front elevation view thereof;

FIG. **3** is a rear elevation view thereof;

FIG. **4** is a side elevation view thereof;

FIG. **5** is a top plan view thereof;

FIG. **6** is a bottom plan view thereof;

FIG. **7** is an exploded view of the handle bar assembly and its rack mounting structure;

FIG. **8** is a side view of a frictional rotational resistance device in the form of a disc brake assembly;

FIG. **9** is a front view thereof mounted on the handle bar rack mounting assembly;

FIG. **10** is a perspective view of an alternative embodiment of a floor and wall-mounted exercise rack with handle bar assembly mounted thereon;

FIG. **11** is a perspective view of another alternative embodiment of a wall-mounted exercise rack with handle bar assembly mounted thereon;

FIG. **12** is a perspective view of the handle bar assembly with an alternative frictional rotational resistance device in the form of a drum brake assembly;

FIG. **13** is a schematic side view of a non-contact magnetic rotational resistance device; and

FIG. **14** is a front view thereof mounted on the handle bar rack mounting assembly.

All drawings are schematic and not necessarily to scale. A reference herein to a figure number herein that may include multiple figures of the same number with different alphabetic suffixes shall be construed as a general reference to all those figures unless specifically noted otherwise.

DETAILED DESCRIPTION

The features and benefits of the invention are illustrated and described herein by reference to exemplary embodiments. This description of exemplary embodiments is intended to be read in connection with the accompanying drawings, which are to be considered part of the entire written description. Accordingly, the disclosure expressly should not be limited to such exemplary embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features.

In the description of embodiments disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as “lower,” “upper,” “horizontal,” “vertical,”, “above,” “below,” “up,” “down,” “top” and “bottom” as well as derivative thereof (e.g., “horizontally,” “downwardly,” “upwardly,” etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation. Terms such as “attached,” “affixed,” “connected,” “coupled,” “interconnected,” and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise.

As used throughout, any ranges disclosed herein are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range.

Referring initially to FIGS. **1-6**, a rotary exercise system generally comprises a rotary apparatus in the form of handle bar assembly **20** rotatably mounted to a chassis **21** configured for detachable mounting to and between at least two vertical uprights or supports **22** of a stationary support frame or structure. In one non-limiting embodiment, the support structure may be a free-standing power rack **24** as shown comprising fours vertically elongated support members **22** and a plurality of horizontal cross members **23** spanning between the support members to form a rigid space frame. The bottom ends of the support members **22** are configured for engaging a generally flat floor support surface **25** of any suitable type and construction. Support members **22** and cross members **23** are metal structural elements (e.g. steel, aluminum, and/or titanium) which may be solid or have an open tubular construction for weight reduction. Cross members **23** may be permanently attached to the vertical support members **22** or removable attached thereto such as via fasteners as shown.

In one non-limiting embodiment, the chassis **21** may comprise a first (e.g. right) and second (e.g. left) mounting rack assembly **26**. The mounting rack assemblies **26** may be specifically configured for detachable securement to the vertical supports **22** of the power rack **24** or alternatively the vertical supports of another type support structure. In one embodiment, each mounting assembly **26** comprises a mounting bracket **27** complementary configured and dimensioned to the transverse cross-sectional shape and size of the vertical supports **22**. Brackets **27** may be three-sided collar in one embodiment comprising an open rear, opposing front wall, and two adjoining sidewalls extending perpendicularly rearward from the front wall. Brackets **27** further define a cavity **28** therein for receiving and securing the vertical support **22**. Each bracket **27** may be attached to a vertical support **22** by horizontally inserting the support into cavity **28** of the bracket. When the vertical supports **22** are inserted into the cavities **28**, the brackets **27** are vertically slideable along the vertical supports of the rack **24** to a user-selectable desired mounting position or height of the handle bar assembly **20**. Each bracket includes one or more mounting holes **29** which are concentrically alignable with corresponding mounting holes **30** formed the vertical supports **22** of the power rack **24**. Removable fasteners **31** such as without limitation bolts or pins are provided for insertion through each pairs of aligned holes **29**, **30** for securing and fixing the bracket in position on the power rack. Pins if used for fasteners **31** may be any type or configuration compatible for use with the holes of the power rack vertical supports **22**.

It bears noting that the three-sided mounting bracket **27** allows the chassis **21** to be mounted to the power rack **24** without partially disassembling the rack. In other possible embodiments, however, the centrally open brackets **27** may be have a completely enclosed tubular cross-sectional shape thereby forming an annular collar with four opposing perpendicular walls (see, e.g. FIG. **7**) that completely encircles the power rack vertical support **22** when inserted through the cavity **28** of the bracket. This latter design is mounted by vertically sliding the bracket onto the top end of the rack vertical support **22** and sliding the bracket downward to the desired mounting position. Of course, other configurations of mounting brackets **27** may be used in other embodiments beyond the foregoing non-limiting examples so long as the chassis may be fixedly attached to the rack vertical supports **22**. In yet other possible implementations, the mounting brackets **27** may be non-removably and permanently attached to other types of dedicated support structures with vertical supports such as via welding.

It will be appreciated that the rotary exercise system is not limited in its applicability to free standing power racks alone, which represented only one of many possible mounting options. In other possible embodiments, the chassis **21** of the exercise system may be attached to a wall mounted power rack **240** as shown in FIG. **10**. This rack comprises two vertical support members **22** configured to rest on a support surface. These support members **22** are each anchored near both the top and bottom ends to a wall structure by horizontal supports **23**. The horizontal supports **23** are configured for mounting to the wall structure, and may include end flanges **230** with holes to receive fasteners as depicted or other appurtenances to facilitate anchoring to the wall structure. In yet other possible embodiments, entirely wall mounted vertical members **22** may be provided as shown in FIG. **11** which do not extend to the floor. Such a construction comprises a box frame with shortened height comprising four vertical support members **22** and horizontal supports **23** extending therebetween as shown. The rear vertical members **22** are attached to a wall structure and the front two verticals are used for mounting the rotary exercise system. This mounting rack is dedicated solely to the rotary exercise machine and may be a self supporting unit including the mounting rack and rotary handle bar unit and all appurtenances described further herein. Accordingly, it will be clear to those in the art that numerous mounting variations of the rotary exercise system are possible and does not limit the invention.

The present rotary exercise system is further not limited to mounting on vertical supports of "power racks" or portions thereof. Instead, the system only requires two rigid and stationary members of any orientation for mounting and is thus not limited in its applicability by the construction of the structure that supports stationary members. For example, although the figures depict horizontal mounting of the exercise system on a pair of vertical supports (i.e. handle bars extending horizontally), it will be appreciated that the exercise system may be used in a vertical orientation with

the handle bars extending vertically instead. In this case, the main support members **22** may instead be oriented horizontally for securing the chassis **21** thereto. Such an orientation would allow other types of exercise motions to be performed by the user (e.g. pulling on the handle bars with one arm and pushing the handle bars with the other arm).

The structure of the handle bar assembly **20** will now be described. Referring to FIGS. **1-7**, the rotary handle bar assembly **20** includes a central or main rotational support shaft **41** and plurality of handle bars **40** coupled to the support shaft and rotatable therewith. Support shaft **41** defines an axis or rotation RA of the handle bar assembly. In one embodiment, support shaft **41** and handle bars **40** may each have an elongated cylindrical shape which may have a textured or knurled surface to facilitate gripping by the user. In other embodiments, handle bars **40** may have different shapes or be other entirely different type elements such as without limitation ball grips, rock climbing handles or grips, towels, pegs, ropes, etc.

Handle bars **40** may be coupled to support shaft **41** by a support frame comprising a pair of side support structures **42** laterally spaced apart on the shaft. In one embodiment, each side support structure **42** may include an X-shaped lateral support member **43** rigidly attached to the support shaft **41** such as via welding to be rotatable in unison therewith. Other forms of rigid attachment such as bolting, etc. may be used. Each lateral support member **43** may comprise four radial arms **46** in one embodiment which intersect perpendicularly at the support shaft **41** and extend radially outward therefrom as illustrated. The lateral support members **43** may be located inboard on the rotational support shaft **41** such that an outboard end portion **48** of the main support shaft **41** extends laterally outwards for a distance beyond each support member **43** for rotational mounting to each side mounting rack assembly **26**, as further described herein.

The lateral support members **43** may be constructed by casting or forging as a monolithic unitary structure with each radial arm **46** being an integral part thereof. In other embodiments, lateral support members **43** may be constructed from two or more structural elements welded together. In the non-limiting illustrated embodiment, the arms **46** may have a rectilinear cross-sectional shape such as rectangular or square (i.e. rectangle with even sides). Other shapes however may be used. The arms **46** may comprise hollow solid structure or tubular structures for weight reduction. Lateral angle braces **47** may be attached between each adjacent arm **46** as shown to add structural rigidity to the lateral support member **43**. Braces **47** are obliquely angled to the radial arms **46**.

Although each lateral support member **43** is depicted as an open frame polygonal structure in the illustrated embodiment to reduce weight, it will be appreciated that other configurations of these support members may be used. For example, in other embodiments lateral support members **43** may each be configured and formed as round disks fixedly attached to the main support shaft **41**. Each disk may have a solid structure or a partially open structure with cutouts formed in the disk material to reduce weight. The handle bars **40** are attached at their ends to the disks. In some embodiments, the lateral support members **43** may each be configured as a spoked wheel having a central hub fixedly attached to the main support shaft **41**, an outer circular and annular wheel to which the handle bars **40** are attached, and a plurality of spokes extending radially between the hub and wheel in a well-known manner. Accordingly, the lateral support members **43** are not limited to any particular configuration so long as the handle bars **40** may be rigidly supported from the main support shaft **41**.

The side support structures **42**, main rotational support shaft **41**, handle bars **40**, and mounting rack assemblies **26** are preferably formed of a suitably strong metal for their given application, such as steel, aluminum, titanium, or other. A combination of metals may be used for different parts and need not all be the same. The components may have a solid structure or comprise hollow tubular elements for weight reduction.

With continuing reference now to FIGS. **1-7**, opposing ends **45** of each handle bar **40** are attached to one of the radial arms **46** of each X-shaped lateral support member **43**. In one embodiment, the handle bars **40** may be attached proximate to the terminal free end of each arm **46** as shown. Handle bars **40** may be oriented parallel to the main support shaft **41**. When constructed, the handle bars may be arranged to encircle the support shaft **41** as shown and are positioned to be readily graspable by a user. In operation, a user manually pulling or pushing on one of the handle bars **40** rotates the main rotational support shaft **41** vis-á-vis the side support structures **42**. In one embodiment, the handle bars **30** may be rigidly attached to the lateral support members **46**. In other embodiments, the handle bars **30** may be rotatably attached to the lateral support members **43** and may be freely rotatable in relation thereto.

In the illustrated embodiments, four handle bars **40** are provided based on the shape of the X-shaped lateral support members **43** each having four arms for mounting the handle bars. In other possible embodiments, other configurations of side support structures **42** may be provided having more or less number of arms; thereby changing the number of handle bars which may be used. For example, in some alternative embodiments the side support structures may each have six equal spaced arms instead of four thereby allowing six handle bars to be provided. Accordingly, the invention is not limited to any particular number of handle bars although preferably at least four are provided so that the user does not have to reach overly far to grab the next successive handle bar **40** as the handle bar assembly **20** rotates during the exercise routine.

Referring now to FIGS. **1-7**, each mounting bracket **27** further includes a support bushing **32**. Bushing **32** have a hollow tubular shape and receive the outboard free end portions of the main rotational support shaft **41** therein as shown. The bushings **32** are preferably formed of as suitably strong metal and are rigidly attached to the mounting brackets **27** by any suitable means, such as welding. The interior circumferential surfaces of the bushings **32** provide annular bearing surfaces which support both ends of the support shaft **41**, and thus transmit the weight of handle bar assembly **20** and user (when hanging therefrom) to mounting rack assemblies **26** and in turn to the power rack vertical support members **22**. The support shaft **41** of the handle bar assembly **20** is rotatable inside the bushings **32**, thereby rotatably mounting the support shaft **41** to the chassis **21**. In one embodiment, the opposing terminal end portions **48** of the support shaft **41** protrude outwards beyond the bushings **32**. This allows a removable travel stop **49** or other retention device to be secured to each end portion **48** of the shaft for trapping the handle bar assembly **20** between the side mounting rack assemblies **26**, thereby collectively forming a single unit that can be easily transported and mounted on the power rack vertical support members **22** by the user. In various embodiments, for example without limitation, the travel stops **49** may comprise an assembly of a bushing or washer **68** and fastener **67** threaded into an axial threaded bore **66** formed in the ends of the shaft **41** as shown in FIG. **7**, an assembly of a washer and cotter pin extending through a through-bore formed transversely through the end portion of the shaft **41** (not shown), or any other suitable part or assembly of parts operable to prevent the support shaft from pulling through the two spatially separated bushings **32**. It is well within the ambit of those skilled in the art to provide a suitable travel stop and shaft retention device.

The rotary exercise system further comprises at least one a user-adjustable rotational resistance assembly or mechanism **50** operably coupled to the main rotational support shaft **41**. Resistance mechanism **50** is operable to apply a variable resistance on the support shaft **41** having a level of resistance which may be preselected by the user. The greater the resistance applied to the support shaft **41** by resistance mechanism **50**, the harder it would be for the user to turn the handle bars **40**, and vice-versa. Accordingly, the handle bar assembly **20** is not free spinning, thereby improving the exercise benefit in addition to allowing rotation of the handle bars **40** about the support shaft **41** in a controlled manner. Any suitable type of resistance device or mechanism may be used, including without limitation a frictional resistance mechanism, a magnetic resistance mechanism, a hydraulic fluid resistance mechanism, or a hydraulic or pneumatic cylinder resistance system.

In one embodiment, the frictional based resistance system may comprise a brake system such as a disc or drum brake mechanism. These type mechanisms are used in various types of bikes such as exercise and mountain bicycles, and other applications, and are well known in the art without undue elaboration.

One example of a frictional resistance mechanism **50** is shown in FIGS. **7-9**. In this non-limiting embodiment, the resistance mechanism **50** may be a commercially-available disc brake unit **72** generally comprising an assembly of a rotor **53** fixedly but preferably not permanently attached to the main rotational support shaft **41** to rotate therewith and brake pad assembly. Rotor **53** is centered between a pair of disc brake pads **52***a*, **52***b* each supported by an adjustable caliper **51** in a well known manner. The spaced apart brake pads **52***a*, **52***b* are laterally and axially movable (parallel to the rotational axis RA of support shaft **41**) toward or away from the rotor **53** to compress the rotor therebetween with varying degrees. This creates frictional resistance that impedes rotation of the main rotational support shaft **41** by the user when turning the handle bar assembly **20**.

The rotor **53** may be fixedly attached to the support shaft **41** by numerous methods; one non-limiting example of which is shown and described herein. The rotor mount may include a bolted flange **70** permanently mounted on rotational support shaft **41** such as via welding. A plurality of fasteners **71** such as bolts or screws pass through holes in the flange **70** and corresponding holes in the central hub portion of the rotor disc for securing the rotor **53** to the flange in fixed manner. This arrangement allows the rotor to be readily replaced if necessary. Rotor **53** may be a relatively thin solid circular metal disc (disk), or alternatively may be a ventilated disc including cutouts such as variously shaped holes and slots (see, e.g. FIG. **7**) to dissipate the heat of friction generated by the braking force and reduce weight. Ventilated rotors are commonly used for example in bicycle disc brake systems and other applications, and are well known in the art. Rotor **53** may be protected by removable covers **69** mounted to the mounting rack assemblies **26** (see, e.g. FIGS. **1** and **7**).

A fixed or floating type caliper **51** may be used. In a fixed type caliper, the caliper remains stationary in axial position relative to the rotor **53**. The brake pads are mounted to a pair of pistons on the caliper and each move axially inwards to clamp the rotor from each side.

Conversely, in the floating type caliper **51** shown and described herein, inner and outer portions of the segmented caliper body move relative to each other and the rotor. This type of caliper is typically less complex and expensive than a fixed type caliper. In the floating brake caliper **51** disclosed herein, the outer brake pad **52***b* is mounted on the outboard brake piston portion **54** of the segmented caliper body and inner brake pad **52***a* is mounted on the opposite inboard sliding caliper portion **55** of the body, respectively. Portions **54** and **55** are axially movable together and apart with respect to each other and the rotor **53**.

In operation, the piston portion **54** of the caliper body pushes the outer brake pad **52***b* inwards when activated by a cam lever **54** operably coupled thereto until the pad engages the outward facing lateral braking surface of the rotor **53**. The piston portion **54** thus cannot move any farther toward the rotor, which in turn causes the caliper to then pull the opposing sliding caliper portion **55** of the caliper body outwards towards the piston portion until inner brake pad **53** also engages the inward facing lateral braking surface of the rotor. This squeezes the rotor **53** between the brake pads, thereby creating frictional and rotational resistance to turning the handle bar assembly **20**. The frictional braking force or pressure is applied to both sides of the rotor **53** in a direction parallel to the axis or rotation RA of the support shaft **41** and rotor **53**. The distance between the brake pads **52***a*, **52***b* is therefore primarily controlled by the position of piston portion **54** of the caliper body, which in turn activates the opposing sliding caliper portion **55**. Suitable floating caliper mechanical disc brake units that may be used in the present invention include MB1 Series units commercially available from Airheart Brake (Tolomatic Inc. of Hamel, Minn.) or other suppliers.

With continuing reference to FIGS. **7-9**, the disc brake unit **72** may be mounted to and supported by one of the mounting rack assemblies **26**. In one embodiment, the brake mount may include a first bracket **73** specially configured to engage or mounted the brake unit such as caliper body **63**. Bracket **73** is in turn mounted to a second bracket **60** attached to the respective mounting rack assembly **26**. The brake unit **72** may supported in a cantilevered manner as shown for positioning of the caliper **51** in proper relationship to the rotating rotor **53** and support shaft **41**. Any materials and configurations of brackets may be used. It bears noting that although the brake unit **72** is shown mounted above the rotor **53** in the illustrated embodiment, any mounting position may be used including on the sides or beneath the rotor so long as the brake pads are engageable with the opposing side surfaces of the rotor.

According to one aspect of the invention, the frictional resistance mechanism **50** is user adjustable to allow the user to preselect and set a desired rotational resistance for the rotary exercise system. The disc brake caliper **51** may be operated and adjusted by a resistance control system, which may be either a mechanical or hydraulic mechanism; both of which are well known in the art. A mechanical resistance adjustment mechanism is shown herein as one non-limiting example. In one embodiment, a mechanical resistance adjustment mechanism may comprise cam lever **61** which is pivotably mounted on the caliper body **63**. Lever **61** is connected to one top end of a control linkage such as metal wire control cable **62**. The other bottom end of the cable is connected to a manual control actuator **65** which is coupled to and operable to push and pull the control cable **62**, thereby transmitting a force to and pivoting the cam lever **61** in a known manner which adjusts the braking force or resistance. The control actuator **65** may be mounted to mounting rack assembly **26** by a mounting support **64** of any suitable configuration, such as a metal bracket.

Any suitable type of commercially available control actuator **65** may be coupled to the control cable **62**, such as a rotary knob, pivotable lever, or other style user interface. A rotary control knob form of an actuator **65** is shown in the non-limiting illustrated example herein. Control cables and control actuators are commercially available from manufacturer's such as Glendinning Products, LLC of Conway, S.C. and others. Control actuator **65** has a plurality of user selectable resistance settings which changes the rotational resistance applied to the support shaft **41** of the handle bar assembly by the frictional resistance mechanism. Adjusting the control actuator to select one of the resistance settings increases or decreases a physical force required to be exerted manually by the user on the handle bars in order to rotate the handle bar assembly **20**. Indicia may be included on the control actuator (e.g. knob or lever) to mark various rotational resistance settings, thereby providing repeatability of desired resistance settings by the user.

To adjust the rotational resistance applied to rotor **53** and in turn the handle bar assembly **20** by the disc brake system described above, the user rotates the resistance control knob (actuator **65**) clockwise or counter-clockwise to the desired setting. The actuator **65** pushes or pulls the control cable **62** depending on the direction that the knob is rotated. The force transmitted by the cable **62** activates and pivots the cam lever **61** on the brake caliper **51**, which either pushes the piston portion **54** towards further engagement with the rotor **53** or withdraws the piston portion therefrom thereby concomitantly moving the sliding caliper portion **55** of the caliper towards or away from the rotor, as described above. For example, when the control knob actuator is turned clockwise, the knob mechanism may pull the control cable **62** and cam lever **61** downward. An angled surface on the cam lever **61** pushes the brake piston portion **54** inwards towards the rotor **53** as the lever rotates. This correspondingly pulls the sliding caliper portion **55** of caliper **51** outwards towards the rotor, thereby pressing the both brake pads **52***a*, **52***b* against the rotor to increase friction, thus increasing rotational resistance in the system. Conversely, when the control knob actuator is turned counter-clockwise, the knob mechanism may push the control cable **62** and cam lever **61** upward instead. When the cam lever **61** pivots in this opposite direction, the angle on the cam lever allows the brake piston portion **54** to move outward and separate the brake pads **52***a*, **52***b* from the rotor **53** to decrease friction, thus decreasing rotational resistance in the system. The control actuator **65** therefore effectively changes the rotational resistance on the rotational support shaft **41** in a manner preselected by the user before the exercise routine begins.

In some embodiments, at least a single variable resistance mechanism such as the disc or drum brakes or other type resistance device described herein may be provided to apply rotational resistance to the rotational support shaft **41** of the handle bar assembly **20**. In other embodiments as shown herein, a variable resistance mechanism may be coupled to each end of the support shaft **41** to impart a balanced resistance force to each side of the handle bar assembly **20**.

A method of operation and use of the rotatable handle bar assembly **20** when the device is used as a pull-up bar will now be briefly explained. If the power rack **24** or **240** of FIG. **1** or **10** are used, respectively, the user may first select a desired mounting height/position of the handle bar assembly **20** on the vertical support members **22**. Assuming the user wishes to perform pull-ups freely hanging from the handle bars **40** in this non-limiting example, the user positions the chassis **21** (i.e. mounting rack assemblies **26** along the vertical support members **22** at a height preferably so that the user will be freely suspended from the handle bars **40** when the lower-most handle bar is in a bottom vertical position as the handle bar assembly rotates. The user concentrically aligns the mounting holes **29** in each mounting rack assembly **26** with corresponding mounting holes **30** in the vertical support members **22**, and then inserts a suitable fastener **31** therethrough. A lockable type fastener may be used to prevent inadvertent pullout of the fastener from the mounting holes. The rotary exercise system is now readied for use.

As the user jumps, grasps, and hangs from one of the handle bars **40** which is not directly underneath the rotational support shaft **41** (e.g. between the 12 and 6 o'clock positions), the user's bodyweight creates a downward force from gravity transmitted to the side support structures **42** to which the handle bars are attached. This in turn creates a torsional force acting on the rotational support shaft **41** which rotates with the rotor **53** mounted thereto about the axis of rotation RA. The torsion force acting around the axis of rotation RA causes the rotational support shaft **41** to rotate, thus rotating the handle bar assembly **20** and all of the handle bar members fixed to it. As the rotor **53** rotates, friction is created between the rotor and the brake pads **52***a*, **52***b*, and the rotational resistance continues along with the rotation until the user is no longer in a moment or torsion generating position (e.g. hanging directly underneath the axis of rotation). As the user climbs from one handle bar to the next higher one not directly beneath the support shaft **41**, the torsional force will again be created and the fitness apparatus will continue to rotate as the user successively climbs from one handle bar to the next.

In engineering terms, the foregoing torsional force or torque (T) created by the user on the support shaft **41** (i.e. axis of rotation RA) is the product of the weight of the user (force F) and the distance (r) between the support shaft and the user (i.e. linear distance between the handle bar **40** and support shaft which is the moment arm). In this case, the moment arm (distance r) is represented by half the length of the radial arms **46** of the side support structures **42**. Torque is expressed in units of foot-pounds or Newton-meters.

It bears noting that the angular speed that the handle bar assembly **20** will rotate is determined by the difference between the weight of the user and the frictional resistance preselected and set by the user for the frictional resistance mechanism **50**. This allows the user to select the "climbing" speed from fast to slow. If the torsional force created by the user does not exceed the frictional resistance force selected by the user, the handle bar assembly **20** will not rotate at all. Accordingly, the frictional resistance setting used will vary with the weight of the user. Notably, the user may use the lowest-most handle bar **40** at the 6 o'clock bottom position for performing standing pull-ups. The torque neutral position will not cause the handle bar assembly **20** to rotated because there is no moment arm created by the force or weight of the user when hanging from this bottom handle bar.

It will be appreciated that the user may alternatively mount the handle bar assembly **40** at other positions on the vertical support members **22** (e.g. shoulder height, waist height, or below) to perform various types of exercises with the arms and legs. When mounted proximate to the exercise floor support surface **25**, the user may lie on his/her back and rotate the device with the legs. Positions above this low mounting position may be used to perform various exercises with muscle groups other than the legs. Notably, the handle bar assembly **20** can advantageously be rotated in opposite directions with the same resistance force applied by the variable resistance mechanism **50**. This expands the versatility of the rotary exercise system.

An example of a commercially available drum brake unit **90** that may be used as the frictional resistance mechanism will now be described with reference to FIG. **12**. Such units, well known in the art without undue elaboration, generally comprise a flanged hub (not shown on far side) which is fixedly mounted on the rotational support shaft **41** of the handle bar assembly **20** and rotates therewith. An annular brake drum **92** is mounted to the flange hub such as via fasteners (e.g. bolting or screws) using mating holes in the hub and drum to rotate the brake drum with the support shaft **41**. The brake assembly **93** is positioned inside the drum and includes arcuately shaped brake shoe and pads **95** coupled to a piston assembly, which moves the brake pads radially outwards to engage the interior surfaces of the arcuately shaped sidewall of the brake drum **92** thereby creating friction. This creates rotational resistance on the rotations support shaft **41** of the handle bar assembly. A control or cam lever **94** is internally coupled to the piston and brake pad assembly which moves the brake pads to increase or decrease frictional resistance between the drum and pad. The control actuator **65** and control cable **62** attached to the cam lever **94** as already described herein may be used to allow the user to increase or decrease the rotational resistance. Such commercially available drum brake units suitable for this application

FIGS. **13** and **14** are schematic diagrams showing one example of a non-contact magnetic resistance mechanism **100** that may alternatively be used in lieu of the friction resistance system are common in spinning bikes and well known in the art. Instead of frictional resistance which generates heat and wear, magnetic rotational resistance is non-contact and generated from electro magnetic currents that vary in strength based on the proximity of magnets to the rotor. An adjustment mechanism allows the user to vary the distance between the magnets and the rotor to vary the drag placed on the rotor or rotational resistance. Referring to the foregoing referenced figures, the chassis **21** is similar to the embodiments already described herein except for omission of the specific brackets used to mount the disc brake unit. Rotor **53** is rotationally fixed to the support shaft **41** in the same manner and centered between a pair of magnets **104** which may be fixedly mounted on one end of a pivotally movable U-shaped clevis section of a lever arm **101**. The lever arm may be roughly L-shaped and mounted below the rotor **53** in one embodiment. Other mounting positions may be used. One magnet **104** is mounted on each branch of the clevis in opposing relationship. The lever arm **101** may be pivotably mounted by a pivot **103** to a mounting bracket attached to the mounting rack assembly **26**. In one embodiment, the mounting support **64** used for the control actuator **65** may be configured and also used for the mounting bracket of the pivot **103**; however, a separate bracket may also be used and mounted to the mounting rack assembly **26**. The pivot **103** may comprises a pin or fastener (illustrated) which extends through the body of the lever arm **101**. In one, the pivot **103** may be located approximately midway between the opposing ends of the lever arm **101** as shown. Other locations for the pivot however may be used.

The adjustment mechanism for the magnetic actuator **100** may comprise the same control cable **62** and actuator **65** previously described herein. The control wire **62** may be attached to the other end of the lever arm **101** opposite the clevis section with the magnets **104**. Raising and lowering the control cable **62** via rotating the knob-shaped actuator **65** causes the opposite clevis end of the lever arm **101** with magnets to pivotably move about pivot **103** either towards or away from the rotor, thereby concomitantly increasing or decreasing the rotational resistance force induced by the magnets on the rotor and handle bar assembly **20** respectively. Such magnetic resistance mechanisms are commercially available.

Hydraulic fluid resistance systems that may alternatively be used generally comprise a contained hydraulic fluid in an confined space in conjunction with a rotating impeller therein that provides smooth, steady resistance during rotation of the rotational support shaft **41**.

A hydraulic or pneumatic cylinder containing a compressible fluid mounted in conjunction with the rotor may also alternatively be used to create rotational resistance. The cylinder may be rotatably mounted at one end to the mounting rack assembly **26** and the cylinder rod projecting from the other end may be mounted to the rotor **41** and is movable therewith. As the support shaft **41** and rotor **53** fixedly mounted thereto rotates around the rotational axis RA, the cylinder rod extends and retracts in a reciprocating motion in conjunction with rotation of the rotor to which it is mounted. Whether the cylinder is extending or retracting, the linear force imparted to the cylinder rod by the compressible fluid within the cylinder is translated into rotational resistance imparted to the rotor **53**.

Although handle bars **40** depicted herein have a single fixed location on each radial arm **46** of the lateral support members **43**, in other embodiments the mounting position of the handle bars on the handle bar assembly may be adjustable. As shown in FIG. **7** represented by the dashed circles depicting alternate handle bar mounting positions, each radial arm **46** may have multiple user-selectable handle bar mounting hole **220** locations **220** in which the handle bars **40** may be mounted. Using through holes **220** in the radial arms **46**, the handle bars **40** may be tapped on each end with an axial threaded bore and bolted to the radial arms at a desired location thereby allowing users to adjust the position of the handle bars. By adjusting the position of the handle bars **40** inward or outward on the radial arms **46**, the radius of rotation and the torsional force change accordingly.

For example, when mounted in holes **220** located closer to the axis of rotation RA, the distance between handle bars becomes closer and users have less of a reach to grasp the next bar. This makes climbing the rotating system less of an effort and accommodates weaker and/or smaller users. When mounted in holes located farther from the axis of rotation, the distance between hand grips becomes larger and users have a greater reach to grasp the next grip. This makes climbing the rotating system more of an effort and accommodates stronger and/or larger users.

It will be appreciated that the handle bar assembly **20** may be mounted at varying heights along the vertical support members **22** in the manner describe herein. This allows different types of exercise routines to be performed and can work numerous different muscle groups. For example, the handle bar assembly may be mounted near the floor and the user may rotate the handle bars with their legs while lying on the back. In another example, the handle bar assembly may be mounted to be reachable at standing height allowing the handle bars to be grasped and rotated while the user is standing on the floor. In yet another example, the handle bar assembly may be mounted above the user's head at a height which requires the user to jump to grab the handle bars. In this case, the user will be completely elevated off the floor while successively gripping one handle bar after another as the handle bar assembly rotates. Accordingly, the invention is limited by the height at which the handle bar assembly is used.

While the foregoing description and drawings represent preferred or exemplary embodiments of the present invention, it will be understood that various additions, modifications and substitutions may be made therein without departing from the spirit and scope and range of equivalents of the accompanying claims. In particular, it will be clear to those skilled in the art that the present invention may be embodied in other forms, structures, arrangements, proportions, sizes, and with other elements, materials, and components, without departing from the spirit or essential characteristics thereof. In addition, numerous variations in the methods/processes as applicable described herein may be made without departing from the spirit of the invention. One skilled in the art will further appreciate that the invention may be used with many modifications of structure, arrangement, proportions, sizes, materials, and components and otherwise, used in the practice of the invention, which are particularly adapted to specific environments and operative requirements without departing from the principles of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being defined by the appended claims and equivalents thereof, and not limited to the foregoing description or embodiments. Rather, the appended claims should be construed broadly, to include other variants and embodiments of the invention, which may be made by those skilled in the art without departing from the scope and range of equivalents of the invention.

What is claimed is:

1. A rotary exercise system comprising:

a chassis configured for detachable mounting between a pair of stationary elongated support members in a plurality of user-selected mounting heights;

an elongated rotational support shaft rotatably supported by the chassis, the support shaft rotatable in opposing directions about an axis of rotation;

a plurality of handle bars coupled to the support shaft and rotatable therewith, the handle bars arranged to encircle the support shaft and be graspable by a user;

a variable resistance mechanism operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user;

wherein adjusting the resistance mechanism increases or decreases a physical force required to be exerted manually by a user on the handle bars in order to rotate the support shaft.

2. The exercise system according to claim **1**, wherein the resistance mechanism comprises a frictional disc brake assembly operably coupled to the support shaft.

3. The exercise system according to claim **2**, wherein the disc brake assembly comprises at least one disc-shaped rotor fixedly coupled to the support shaft and a pair of brake pads frictionally engaged with the rotor, the brake pads moveable towards or away from the rotor to change a frictional force applied to the rotor by the pads.

4. The exercise system according to claim **3**, wherein the brake pads are coupled to a caliper which movably supports the brake pads on opposing sides of the rotor, the brake pad axially moveable into and out of engagement with the rotor.

5. The exercise system according to claim **4**, further comprising a resistance control assembly operably coupled to the caliper, the resistance control assembly comprising a manually adjustable control actuator having a plurality of operating positions and a control linkage that mechanically couples the actuator to the caliper, wherein changing position of the actuator causes the caliper to increase or decrease pressure applied to the rotor by the brake pads for changing the frictional force on the support shaft.

6. The exercise system according to claim **5**, further comprising a cam lever connected to the control linkage and pivotably mounted to the caliper, the cam lever when activated by the control actuator moves the brake pads away or towards the rotor.

7. The exercise system according to claim **1**, wherein the handle bars are oriented parallel to the rotational support shaft.

8. The exercise system according to claim **1**, wherein the handle bars are attached to a support frame rigidly attached to the support shaft and rotatable therewith.

9. The exercise system according to claim **8**, wherein the support frame comprises first and second side support structures fixedly mounted on the support shaft, the handle bars each spanning between the first and second side support structure and attached thereto.

10. The exercise system according to claim **9**, wherein each side support structure includes a plurality of radial arms to which the handle bars are attached.

11. The exercise system according to claim **10**, wherein the radial arms are configured for mounting the handle bars thereon in a plurality of different distances from the support shaft.

12. The exercise system according to claim **9**, wherein the chassis comprises first and second mounting rack assemblies each configured for detachable mounting to one of the elongated support members in a plurality of user-selected mounting heights, the mounting rack assemblies, side support structures, and rotational support shaft being coupled together to collectively form a self-supporting rotary exercise assembly which is transportable as a unit and mountable on the elongated support members.

13. The exercise system according to claim **1**, wherein the rotational resistance mechanism is a magnetic resistance mechanism comprising a rotor fixed to the support shaft and centered between a pair of magnets adjustable in position with respect to the rotor, wherein the rotational resistance created by the magnets on the support shaft changes based on the proximity of the magnets to the rotor.

14. The exercise system according to claim **1**, wherein the frictional resistance mechanism is a drum brake assembly coupled to the support shaft and operable to apply rotational resistance to support shaft.

15. A rotary exercise system comprising:

a pair of spaced apart vertical support members;

a chassis comprising first and second mounting rack assemblies, each mounting rack assembly configured for detachable mounting to one of the vertical support members in a plurality of positions;

an elongated rotational support shaft rotatably supported by the first and second mounting rack assemblies, the support shaft rotatable in opposing directions about an axis of rotation;

a handle bar assembly comprising a plurality of elongated handle bars extending between a pair of side support structures rigidly coupled to the support shaft for rotation therewith, the handle bars arranged for grasping by a user and circumferentially spaced apart around the support shaft;

a variable frictional resistance mechanism operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user;

wherein adjusting the resistance mechanism increases or decreases a physical force required to be exerted manually by a user on the handle bars in order to rotate the support shaft.

16. The exercise system according to claim **15**, wherein the frictional resistance mechanism is a disc brake assembly including a rotor coupled to the support shaft for rotation therewith, a caliper comprising axially movable first and second portions each including a brake pad that frictionally engages the rotor, and a user-operated resistance control mechanism operably coupled to the caliper that moves the brake pads towards or away from engagement with the rotor to increase or decrease a frictional force applied to the rotor respectively.

17. The exercise system according to claim **16**, wherein the disc brake assembly is mounted to and supported by the first or second mounting rack assembly.

18. The exercise system according to claim **15**, wherein the frictional resistance mechanism is a drum brake assembly coupled to the support shaft and operable to apply rotational resistance to the support shaft.

19. The exercise system according to claim **15**, wherein the first and second mounting rack assemblies each include mounting holes which are aligned with mounting holes in the vertical support members, and fasteners are inserted through the aligned mounting holes to lock the first and second mounting rack assemblies in position on the vertical support members.

20. The exercise system according to claim **19**, wherein the first and second mounting rack assemblies are slideable along the vertical support members and have a plurality of mounting positions to adjust the height of the handle bar assembly from a support surface on which a user stands.

21. A rotary exercise system comprising:

a pair of spaced apart vertical support members;

a chassis comprising first and second mounting rack assemblies, each mounting rack assembly configured for detachable mounting to one of the vertical support members in a plurality of positions;

an elongated rotational support shaft rotatably supported by the first and second mounting rack assemblies, the support shaft rotatable in opposing directions about an axis of rotation;

a handle bar assembly comprising a plurality of elongated handle bars extending between a pair of side support structures rigidly coupled to the support shaft for rotation therewith, the handle bars arranged for grasping by a user and circumferentially spaced apart around the support shaft;

a frictional resistance mechanism supported by the first or second mounting rack assembly and operably coupled to the support shaft, the resistance mechanism configured and operable to apply a selectable rotational resistance on the support shaft which is adjustable by the user;

a user-operated control actuator operably coupled to the frictional resistance mechanism, the control actuator having a plurality of user selectable resistance settings;

wherein adjusting the control actuator to select one of the resistance settings increases or decreases a physical force required to be exerted manually by the user on the handle bars in order to rotate the support shaft.

22. The exercise system according to claim **21**, wherein the frictional resistance mechanism is a drum brake or a disc brake assembly.

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